

How Not to Fool Ourselves:
Infusing Cognitive Science into Teaching and Learning
Lancaster Learns
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Beliefs about Learning that Make You Stupid

- Learning is fast
- Being good at a subject is a matter of inborn talent rather than hard work,
- Knowledge is composed of isolated facts
- I'm really good at multi-tasking, especially during class or studying

Metacognition

- A student's awareness of their level of understanding of a topic
- Metacognition distinguishes between stronger and weaker students
- One of the major tasks for a freshman is developing good metacognition
 - In high school, they spent years developing a metacognitive sense that is likely inadequate or even counterproductive for college.

Which of the following is the MOST important ingredient for successful learning?

1. The intention and desire to learn
2. Paying close attention to the material as you study
3. Learning in a way that matches your personal Learning Style?
4. The time you spend studying
5. What you think about while studying

Achieving Deeper Processing

As you study, follow these principles:

- **Elaboration:** How does this concept relate to other concepts? Can I make it a story?
- **Distinctiveness:** How is this concept different from other concepts?
- **Personal:** How can I relate this to my own personal experience?
- **Appropriate to Retrieval and Application:** How am I expected to use or apply this?

Nuthall's Rule of Three

For long-term learning to occur: *A student needed to encounter, on at least three different occasions, the complete set of information she or he needed to understand a concept.* Nuthall (2007, p. 63)

Cognitive Load Theory (e.g. van Merriënboer & Sweller, 2005)

- Mental effort is the amount of concentration that a person has available to devote to tasks
- Mental effort is always a limited resource
- Cognitive Load is the total amount of mental effort a task requires to complete it
- If cognitive load exceeds available mental effort, then performance suffers

Three Types of Cognitive Load (Paas, Van Gog, & Sweller, 2010)

- Intrinsic: Load caused by the complexity of concept to be learned
- Germane: Load caused by pedagogy and activities to learn concept
- Extraneous: Load caused by all factors unrelated to learning concept

Implications of Cognitive Load Theory

- If the cognitive load demanded of students exceeds their available mental effort, then learning will not occur
- If the cognitive load demanded of students takes up most or all of available cognitive effort, then there will not be enough mental effort available for learning or schema formation
- Teachers must monitor, manage and minimize cognitive load to allow schema development as well as design activities to promote schema development

The Curse of Expertise (aka Curse of Knowledge)

- The more one knows about a topic, the harder it becomes to remember not knowing a topic and the effort required to learn that topic
- Experts are overconfident in their ability to explain concepts (Fisher & Keil, 2015)
- Experts are poor at estimating the time and difficulty for novices to learn a concept (Hinds, 1999)

The Cognitive Challenges to Teaching (that we know about thus far)

- 1) Student Mental Mindset
 - 2) Metacognition and Self-regulation
 - 3) Student Fear and Mistrust
 - 4) Prior Knowledge
 - 5) Misconceptions
 - 6) Ineffective Learning Strategies
 - 7) Transfer of Learning
 - 8) Constraints of Selective Attention
 - 9) Constraints of Mental Effort and Working Memory
- And they all interact with each other

Productive Persistence Mindset

1. I belong in this academic community
2. My ability and competence grow with my effort
3. I can succeed at this
4. This work has value for me

Wise Feedback

- Critical feedback must be conveyed as a reflection of the teacher's high standards and not their bias
- Students must be assured that they have the potential to reach these standards
- Students must also be provided with the resources and methods to reach the standards

Resources

Video Series: How to Get the Most Out of Studying

www.samford.edu/how-to-study

Introductory Video: Developing a Mindset for Successful Learning

Video 1: Beliefs That Make You Fail...Or Succeed

Video 2: What Students Should Understand About How People Learn

Video 3: Cognitive Principles for Optimizing Learning

Video 4: Putting the Principles for Optimizing Learning into Practice

Video 5: I Blew the Exam, Now What?

Video Series: The Cognitive Principles of Effective Teaching

<https://www.samford.edu/employee/faculty/cognitive-principles-of-effective-teaching/> or

<http://bit.ly/ILDovLp>

Video 1: Beliefs about Teaching

Video 2: The Cognitive Challenges of Teaching: Mindset, Metacognition, and Trust

Video 3: The Cognitive Challenges of Teaching: Prior Knowledge, Misconceptions, Ineffective Learning Strategies, and Transfer

Video 4: The Cognitive Challenges of Teaching: Constraints of Selective Attention, Mental Effort, and Working Memory

Video 5: Teachable Moments, Formative Assessment, and Conceptual Change

Video on Learning Styles

Learning Styles & the Importance of Critical Self-Reflection by Tesia Marshik for TEDxUWLaCrosse

<http://tedxtalks.ted.com/video/Learning-Styles-the-Importance>

For Further Reading

Books on cognitive research applied to teaching:

Applying Science of Learning in Education: Infusing Psychological Science into the Curriculum (2014). A free e-book written by some of the best researchers in learning sciences:

<http://teachpsych.org/ebooks/asle2014/index.php> or <http://bit.ly/KbYLtG>

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., Norman M. K. (2010). *How Learning Works: Seven Research-Based Principles for Smart Teaching*. San Francisco, CA: Jossey-Bass

Brown, Roediger, & McDaniel (2014). *Make It Stick: The Science of Successful Learning*. Belknap Press.

Cox R. D. (2011). *The College Fear Factor: How Students and Professors Misunderstand One Another*. Harvard University Press.
Miscommunication and conflicting expectations between teacher and student can undermine instruction even when both the student and teacher are motivated to succeed.

Elena Silva and Taylor White (2013). *Pathways to improvement: Using psychological strategies to help college students master developmental math*. Carnegie Foundation for the Advancement of Teaching.
http://www.carnegiefoundation.org/sites/default/files/pathways_to_improvement.pdf An excellent summary of mental mindset as it applies to productive persistence. Although focused on math, the general principles discussed apply to all areas.

Books on Formative Assessment:

Angelo & Cross (1993). *Classroom Assessment Techniques*. Jossey-Bass.

Ritchart, Church, & Morsion (2011). *Making Thinking Visible: How to Promote Engagement, Understanding, and Independence for All Learners*. Jossey-Bass.

Barkley & Major (2016). *Learning Assessment Techniques: A Handbook for College Faculty*, Jossey-Bass.

Blogs and Teaching Resources

- Daniel Willingham: <http://www.danielwillingham.com/>
- Learning Scientists: <http://www.learningscientists.org/ourteam/>
- Retrieval Practice.org: www.retrievalpractice.org
- Deans for Impact: www.deansforimpact.org